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SOUTHERN AREA

REGIONAL POLLUTION CONTROL STUDY

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THE

ONTARIO WATER RESOURCES

COMMISSION

COUNTY OF ELGIN - SOUTHERN AREA

REGIONAL POLLUTION CONTROL STUDY

JUNE - 1967

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ACKNOWLEDGEMENTS

The assistance and advice of employees and representatives of the following are greatly appreciated;

Department of Municipal Affairs,
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County of Elgin

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City of St. Thomas

Town of Aylmer

Village of Belmont
Village of Dutton
Village of Port Stanley
Village of Rodney
Village of Springfield
Village of West Lorne

Township of Aldborough
Township of Delaware
Township of Dorchester, North
Township of Dorchester, South
Township of Dunwich
Township of Malahide
Township of Southwold
Township of Westminster
Township of Yarmouth

The Catfish Creek Conservation Authority

The Kettle Creek Conservation Authority

Lake Erie Regional Development Council

I

PURPOSE AND SCOPE

PURPOSE

Great expectations have arisen recently for increased rates of development in the County of Elgin. These were due largely to the decision of the Ford Motor Company of Canada Limited to locate a major assembly plant in the vicinity of Talbotville. Another major factor in creating interest in the area was the announcement by this Commission of the construction of the Lake Erie Water Supply System which will serve the central area of the County.

The provision of a virtually unlimited supply of good quality water will have the effect of removing one of the main servicing restrictions on development in the central area. However, this would probably necessitate a corresponding expansion of the water pollution control facilities in the area in order to avoid further impairment of surface waters. This report has been undertaken to provide direction in the planning of water pollution control services that would accommodate the development anticipated and protect the water resources of the region.

SCOPE

The report describes the general character of the region and attempts to predict the future population and general land use patterns. An inventory of the water resources of the area has been made with particular emphasis on streamflow and pollution levels. An assimilation study of Kettle Creek, the major drainage basin in the study area, which was completed recently, was an important contribution to the report.

Various water pollution control alternatives are presented in

the report. Those that were considered to be impractical are given only limited coverage and then discarded. The more meritorious schemes are expanded upon in Section V.

In preparation of the report, considerable reference was made to Official Plans, consulting engineer's reports and other pertinent publications. A bibliography of these is appended.

II

SUMMARY AND RECOMMENDATIONS

SUMMARY

Although an increase in the rate of development undoubtedly will occur in the study area, this rate probably will not be as large as was speculated when the Ford Motor Company of Canada Limited announced its intention to build in the vicinity of St. Thomas and the OWRC commenced construction of the Lake Erie Water Supply System. However, this does not reduce the need for communal pollution control facilities in the urban areas within the region. The pollution that exists in the region arises from the discharge of domestic and industrial wastes and waste treatment plant effluents, and leachate from improperly located and operated refuse disposal sites.

The streams in the study area at present do not have sufficient flow at all times throughout the year to accommodate the discharge from the type of sewage treatment facility which produces a continuous effluent. Kettle Creek is grossly polluted downstream from the St. Thomas WPCP. In addition, the effluent from the Ford Motor Company of Canada Limited sanitary sewage and industrial waste treatment plants will soon be discharging to Dodd Creek, a tributary of Kettle Creek. Dodd Creek flows into Kettle Creek at St. Thomas approximately 3 miles above the point of effluent discharge from the St. Thomas WPCP. The water in Catfish Creek at Aylmer approaches the maximum allowable objectives of the OWRC. The only alternatives, if satisfactory stream conditions are to be maintained, are to increase the stream flow or to decrease the waste loading during low flow periods.

For the smaller urban centres, where waste volumes are relatively small and land costs are reasonable, storage of the effluent for discharge during suitable streamflow conditions would seem to be

practical. The one exception to this may be Springfield where a detailed study may indicate that the village could undertake to utilize the treatment facilities at the Ontario Police College; however, effluent holding ponds would still be required. In order to provide a more rational basis to establish the allowable rate of effluent discharge for varying streamflow conditions, assimilation studies could be conducted. However, if an oxygen sag curve cannot be produced, then the rate of effluent discharge should be based on a stream water quality of 4 ppm BOD after initial dilution. For instance, if water in a stream above the point of effluent discharge contains 2 ppm BOD, then an effluent of 15 ppm BOD might be discharged at a rate approximately equal to one sixth of the stream flow. This requires an effluent control structure, which is a mechanical means to control the rate of effluent discharge in direct proportion to the rate of stream flow, which would be measured by a weir or Parshall Flume on the watercourse.

The water pollution control facilities in the City of St. Thomas were extended in 1954 and 1966 and therefore two thirds of the physical plant, which has a rated capacity of approximately 4.5 mgd, has a useful life of about 20 years. In addition the municipality undoubtedly has a considerable outstanding debenture debt on these works. In order to continue using these works, additional flow will have to be provided in Kettle Creek. At least two potential reservoir sites are available on the watershed above St. Thomas. A preliminary investigation of the stream flow and the reservoir sites has indicated that if built and operated for low flow augmentation, a minimum stream flow of approximately 30 cfs could be maintained. Based on the waste assimilation study conducted during low flow conditions, it has been estimated that the aforementioned minimum streamflow would support the effluent from

the St. Thomas WPCP when operating at capacity with an effluent quality not exceeding 15 ppm BOD. With effluent quality control facilities at the WPCP it is estimated that this would be satisfactory to service the St. Thomas area until 1987. At this time, a sewer to a new plant near Port Stanley would serve the St. Thomas urban area, the area between St. Thomas and Lake Erie and the Port Stanley urban area. If for any reason the reservoirs are not built and operated for streamflow maintenance, then the effluent from the St. Thomas WPCP will have to be discharged directly to Lake Erie immediately.

The preceding proposal has a number of merits. Although the proposed reservoirs would be designed for flow augmentation in the initial stages, some use could be made of them for flood control and recreation. After about 1987, the reservoirs could be used entirely for the latter purposes. Since there probably is a need for flood control and recreational facilities in the area, (an example would be the large use of the Fanshawe Lake) it may be possible to obtain grants from the Federal and/or Provincial government. In addition this would be an ideal beginning to planned multiple use of the watershed's capabilities and require close co-operation between this Commission and the Conservation Authorities Branch of the Department of Energy and Resources Management. One further merit that this proposal possesses is that it would allow a period of approximately 20 years before the construction of trunk sewers to Lake Erie will be necessary. During this time, discoveries in the science of wastewater treatment may be made which will make it possible to produce a higher quality effluent that can be discharged to a stream without requiring considerable quantities of dilution water as at present. In that case the construction of trunk sewers to Lake Erie might be postponed for a number of years beyond 1987 or even indefinitely. Staging of

construction of the various works is reasonable and might be accomplished as follows:

1. Build one reservoir above St. Thomas on the Kettle Creek watershed to be used for flow augmentation and provide effluent quality control facilities* at the St. Thomas WPCP immediately.

2. When the augmented flow in Kettle Creek is available, perform additional assimilation studies.

3. Based on the results of the studies, re-evaluate the remainder of the programme.

4. If further flow augmentation would be useful, build a second reservoir on the watershed above St. Thomas.

5. Based on further assimilation studies, estimate the end of the adequacy of this scheme and schedule construction of a sewer to a plant at the lake (approximately 1987).

Some consideration might also be given to the water pollution control facilities that the City of London will require in the future.

To make best use of the existing facilities, industries which generate large volumes of organic industrial wastes in their manufacturing operations should be discouraged from locating in the vicinity of St. Thomas. In addition, development should be encouraged to the south rather than to the north-west as is presently the trend. The extent of development in the immediate vicinity of St. Thomas should be limited to an equivalent population of approximately 40,000 persons. After 1987, re-development of the older sections of the urban area would probably cause an increase in this population. Where new sewers are installed, care should be taken to exclude all uncontaminated surface and ground waters. Under no conditions should combined sewers be installed.

* - These are considered to be flow equalization works to ensure consistent plant hydraulic loading and thus effluent quality.

RECOMMENDATIONS

1. Adequate sewage collection and treatment systems should be provided at all urban centres in the study area, to eliminate the discharge of untreated or inadequately treated sanitary and industrial wastes to the watercourses.

2. Suitable land-use by-laws or official plans should be adopted by the municipalities in the area to control development. If new urban centres are to develop, they should be located such that Lake Erie oriented water pollution control facilities can be provided. Further development in existing urban centres should be restricted unless adequate pollution control works can be provided. This of course takes cognizance of the pre-requisite that sufficient dilutional flow must be available in the receiving stream.

3. Water pollution control facilities for the Town of Aylmer and the Villages of Belmont, Dutton, Port Stanley, Rodney, Springfield and West Lorne should be designed for effluent storage during periods of negligible stream flow and effluent discharge facilities should be provided such that the rate of discharge can be proportional to stream flow.

4. The sewage loading from the St. Thomas urban area should be restricted to the equivalent of that expected from a population of approximately 40,000 persons. Development should be controlled accordingly, with growth beyond this figure being channelled to the south of St. Thomas.

5. Development of the area north and west of St. Thomas should be discouraged.

6. Wastes from the Ford Motor Company of Canada Limited plant should not be discharged to Dodd Creek during low flow periods nor above any reservoir that might be built on the watercourse.

7. Effluent quality control facilities at the St. Thomas WPCP should be built.

8. The possibility of obtaining grants for reservoir construction for low flow augmentation primarily, with secondary flood control and recreational benefits, should be investigated.

9. A reservoir site upstream from the St. Thomas WPCP should be chosen providing significant grants can be obtained. The reservoir should be designed and constructed at an early date.

10. If the reservoir is built, extensive assimilation studies should be undertaken on Kettle Creek when the augmented flow is available to determine more reliably the desirability of further flow augmentation. This of course will depend on whether or not additional reservoir sites are available.

11. If reservoir grants cannot be obtained, or if no suitable reservoir sites exist, a sewer from the St. Thomas WPCP, designed to carry effluent for a period of years and raw sewage beyond that time, should be constructed to Lake Erie.

III

GENERAL

DESCRIPTION OF STUDY AREA

Boundaries

The study area includes all of the south-flowing watersheds in the County of Elgin with the exception of the Big Otter Creek Basin. In general, this includes the south-western and central portions of the County of Elgin, and small sections of three townships in the County of Middlesex and of one township in the County of Oxford. Lake Erie is the southern boundary while the Thames River Watershed is the northern limit. (See Figure 1)

Parts or all of 18 municipalities are in the study region. These are:

City of St. Thomas

Town of Aylmer

Village of Belmont
Village of Dutton
Village of Port Stanley
Village of Rodney
Village of Springfield
Village of West Lorne

Township of Aldborough
Township of Delaware
Township of Dereham
Township of Dorchester North
Township of Dorchester South
Township of Dunwich
Township of Malahide
Township of Southwold
Township of Westminster
Township of Yarmouth

Topography

The surface features of the study area are predominantly plains of stratified clay, clay till or sand, separated by a series of east-west trending recessional moraines. The streams which flow southward to Lake Erie have deeply dissected the adjacent plain areas.

Steep cliffs are present along the shore of the lake rising to a height at places of 125 feet above the water level. The river valleys are generally very steep-sided and flat-floored, and the rivers meander widely.

The surface elevations range from approximately 570 feet above sea level at Lake Erie to over 975 feet in the Township of Dereham.

The nature of the soil in the area varies from clay through clay and silt loams to sandy loam and sand in the southern portion. A thick mantle of overburden generally overlies the bedrock formations. Although considerable thicknesses of sands are present in the sand plain areas and elsewhere as lenses or layers buried within the drift, much of the overburden is composed of clay or clay till materials. Brown and buff limestones of the Delaware formation underlie the overburden from Dunwich Township eastward, while the remainder of the bedrock formations consists of grey shale and limestone of the Hamilton formation. All the bedrock formations dip gradually towards the southwest and the bedrock surface slopes in a southerly direction. Overburden thicknesses may exceed 300 feet near Lake Erie.

Drainage

The region is drained by numerous streams which flow southerly to Lake Erie. Talbot, Kettle and Catfish Creeks are the largest of these. The total area of the study region is approximately 550 square miles of which the largest three watersheds account for approximately 420 square miles.

Due to the soil characteristics and topography, drainage ditches are used extensively throughout the area.

Climate

The study area lies within one of the climatically favourable parts of Ontario, with weather conditions similar to those found to

the west in the County of Essex and to the east in the Niagara Peninsula. However, the temperature range in the region is greater than either of the aforementioned. The average annual temperature is 46° Fahrenheit with average January and July temperatures of 24° and 69° respectively.

The average total precipitation, which is fairly uniformly distributed throughout the year, is 36 inches, with snowfall averaging 47 inches in the St. Thomas area. The usual frost-free period is 168 days.

These climatic conditions are favourable for the growth of algae in surface waters. This is particularly relevant in studying pollution control requirements.

POPULATION

Population projections can be made in various ways and are subject to many methods and opinions. The factors affecting an area are numerous and variable. In any region certain factors become critical and may be limiting. In the study area, it is probable that the more critical factors include the provision of an adequate supply of high quality water, the removal of waste disposal problems and the ability of the area to compete with the more vigorous, faster-growing London area.

The growth rate of the County of Elgin from 1950 to 1966 based on the assessed population as obtained from the Municipal Directory prepared by the Department of Municipal Affairs has averaged less than one per cent per year and from 1960 to 1966 it was approximately one-half of one per cent per year. However in the London-Westminster Township area, the growth rate since 1960 has been almost three per cent per year. In the central portion of the County of Elgin (City of St. Thomas, Village of Port Stanley, Townships of Southwold and Yarmouth) the growth rate was 0.84 per cent per year since 1960.

Discussions with representatives of the Community Planning Branch of the Department of Municipal Affairs revealed that very little of the industrial and residential growth that occurred in the Town of Oakville subsequent to the Ford Motor Company locating there in the early 1950's was directly attributable to that company. Consequently, considering this fact and the proximity of the new Ford plant to the London area with its large number of available residential and industrial ammenities, it was concluded that no large increase in population should be expected immediately in the St. Thomas area.

Table III-1 was developed based on the foregoing considerations by the staff of the Ontario Water Resources Commission. Several reports which contained population projections for the County, specific areas of the County or for individual municipalities were also referred to in the preparation of these population projections. These reports are listed in the appended bibliography.

LAND USE

The present trend towards urbanization is outlined in Figure 2. This plan was developed subsequent to discussions with local, county and provincial planning officials and after studying the available development reports. No attempt has been made to depict the areas which would be most suitable for development considering all of the many planning concepts. No effort has been made to apportion the area according to specific land use, such as residential, industrial, commercial, open space, institutional, transportation and utilities, and agricultural. However, it is probable that the majority of the land in the study region will remain essentially for agricultural purposes. This should be beneficial since the region contains some of the best farm land in the Province of Ontario.

After cursory examination it does not appear that this pattern of development would be too desirable when considering pollution control aspects. It would seem that the provision of pollution control facilities would be less difficult if future development were to locate between St. Thomas and Lake Erie.

Many of the area municipalities have neither official plans nor appropriate land use control by-laws. However, with the recent formation of the Elgin County Planning Board, it is anticipated that adequate control will be provided in the future.

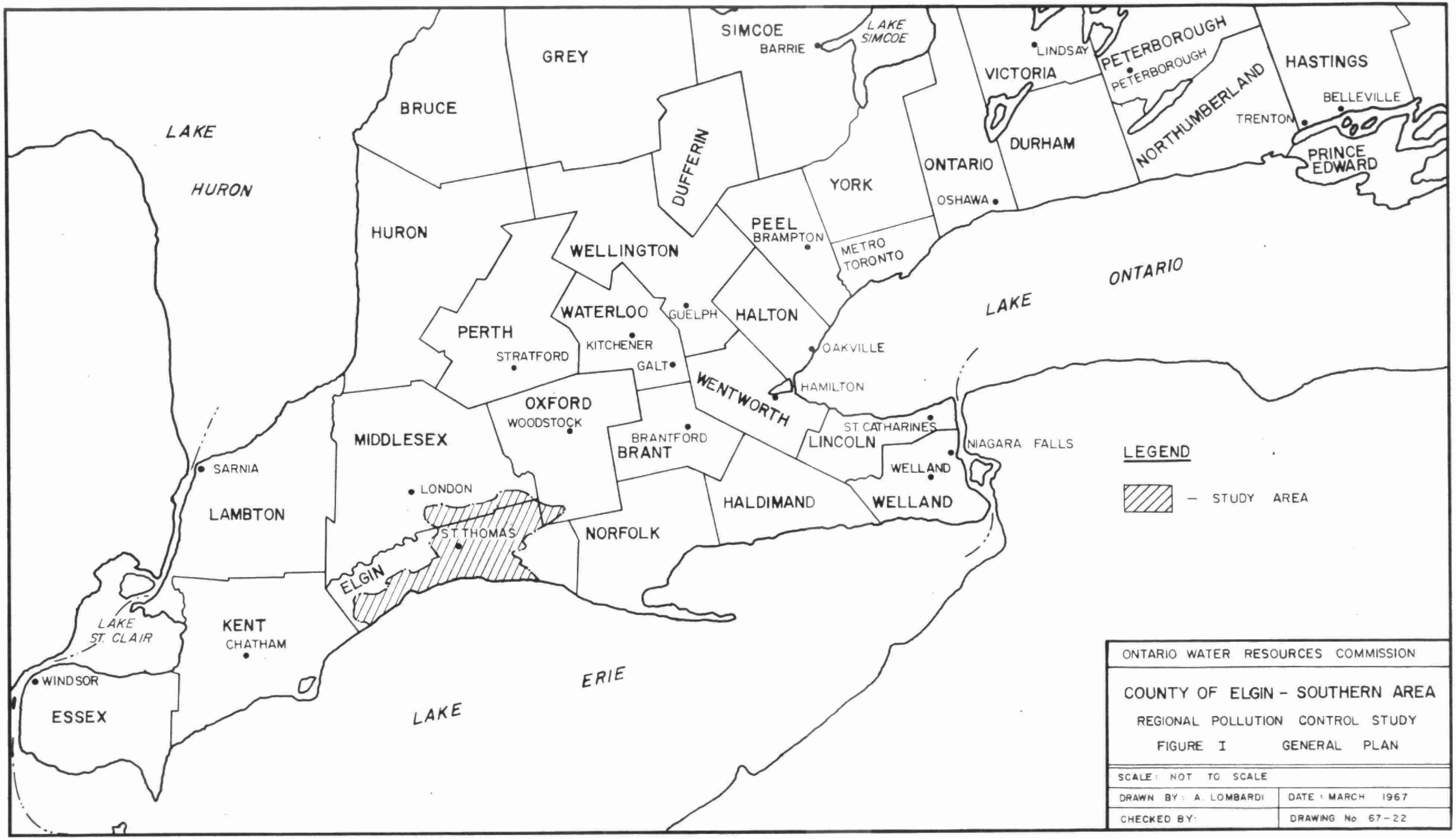
TABLE III - 1

PRESENT AND PROJECTED FUTURE MUNICIPAL EQUIVALENT POPULATIONS

Municipality	1966 Assessed** Population	1972	1977	1987	Ultimate
City					
St. Thomas	22,766	27,500	30,000	34,500	48,000
Town					
Aylmer	4,556	5,500	5,900	6,800	9,400
Villages					
Belmont	724	750	850	950	1,200
Dutton	835	1,000	1,100	1,250	1,700
Port Stanley	1,419	1,700	1,850	2,100	2,900
Rodney	1,084	1,300	1,400	1,600	2,200
Springfield	490	600	650	700	900
West Lorne	1,028	1,200	1,300	1,500	2,000
Townships					
Aldborough*	1,800	1,900	2,000	2,200	2,800
Delaware*	200	225	250	300	400
Dereham*	500	550	600	700	1,000
Dorchester, North*	800	900	1,000	1,150	1,600
Dorchester, South	1,395	1,500	1,600	1,800	2,300
Dunwich*	1,100	1,250	1,350	1,550	2,200
Malahide*	3,775	4,100	4,500	5,200	7,300
Southwold*	3,592	4,100	4,400	5,100	7,100
Westminster*	700	800	850	1,000	1,400
Yarmouth	6,990	8,200	8,800	10,100	14,000
TOTAL	53,754	63,075	68,400	78,500	108,400

* - Only that portion of municipality included in study area - estimated.

** - Obtained from 1967 Municipal Directory prepared by the Ontario Department of Municipal Affairs.


LAKE
HURON
BRUCE
GREY
SIMCOE
BARRIE
LAKE SIMCOE
LINDSAY
VICTORIA
PETERBOROUGH
PETERBOROUGH
HASTINGS
BELLEVILLE
TRENTON
NORTHUMBERLAND
PRINCE EDWARD
DURHAM
ONTARIO
OSHAWA
YORK
DUFFERIN
HURON
PEEL
BRAMPTON
METRO TORONTO
WELLINGTON
WATERLOO
GUELPH
HALTON
PERTH
KITCHENER
STRATFORD
GALT
OAKVILLE
HAMILTON
WENTWORTH
OXFORD
WOODSTOCK
MIDDLESEX
BRANTFORD
BRANT
ST. CATHARINES
LINCOLN
NIAGARA FALLS
WELLAND
WELLAND
LAKE ONTARIO
SARNIA
LAMBTON
LONDON
ST. THOMAS
ELGIN
NORFOLK
HALDIMAND
LEGEND
– STUDY AREA
KENT
CHATHAM
LAKE ST. CLAIR
WINDSOR
ESSEX
LAKE ERIE
ONTARIO WATER RESOURCES COMMISSION
COUNTY OF ELGIN – SOUTHERN AREA
REGIONAL POLLUTION CONTROL STUDY
FIGURE I GENERAL PLAN
SCALE: NOT TO SCALE
DRAWN BY: A. LOMBARDI
DATE: MARCH 1967
CHECKED BY:
DRAWING No. 67-22

IV

SURFACE WATERS

DESCRIPTION OF STREAMS

The westerly part of the region, west of Talbot Creek, consists of a sandy plain and is drained by a number of small creeks. Eight of the more significant streams, some of which are unnamed, vary in length from about 4 to 7.5 miles. Referring to them from west to east these are: two small unnamed creeks; Sixteen Mile Creek which passes through the Village of Rodney and discharges into Lake Erie near Port Glasgow; Ox Creek; Brock Creek which rises near the Village of West Lorne; McKay Creek; an unnamed creek flowing into Lake Erie at Patrick Point; and another unnamed creek which rises near the Village of Dutton and which drains into Lake Erie near Tyrconnell.

The central part of the region is drained by Talbot and Kettle Creeks and by small streams which drain directly into Lake Erie. Talbot Creek rises south of the till moraine dividing the Thames River and Talbot Creek Basins. It has a number of small tributaries rising in the till moraine. Talbot Creek flows into Lake Erie at Port Talbot. Kettle Creek drains the largest basin in the study region. It has two major branches above St. Thomas, Dodd Creek and Kettle Creek. These drain respectively the westerly and easterly part of the upper basin which consists primarily of till ridges and till and clay plains. The branches meet just west of St. Thomas where the stream valley is about 75 feet deep. South of St. Thomas, Kettle Creek meanders in a generally southerly direction through a deeply incised valley in a clay and sand plain and enters Lake Erie at Port Stanley where the shore bluff is about 125 feet above lake level.

The streamflow of Kettle Creek is regulated through the operation of two dams located above the City of St. Thomas where water is

impounded to supply the water works system of that city.

The eastern part of the region is drained by Catfish Creek, the much smaller Silver Creek and a number of small unnamed creeks. Two of Catfish Creek's main tributaries, East and West Catfish Creeks, rise in long troughs between low till ridges. These tributary streams merge north of New Sarum. Catfish Creek proper rises near Brownsville, it flows through the Town of Aylmer and drains a narrow finger of the large sand plains of Elgin and Norfolk Counties. West of Aylmer, Catfish Creek meanders in a westerly direction until it joins with West Catfish Creek south of New Sarum. From this point of confluence, Catfish Creek meanders in a deep, steep-sided but flat-floored valley in a generally southerly direction and enters Lake Erie at Port Bruce. The upper part of the basin consists primarily of clay and clayey till soils, whereas the lower part consists primarily of sandy soils. These latter soils form the "tobacco lands" for which Catfish Creek provides water for irrigation.

Silver Creek rises east of Luton and drains primarily sandy soils. It flows in a generally southerly direction and enters Lake Erie about 3 miles east of Port Bruce. The streamflow is partially regulated due to a dam east of Dunboyne.

Table IV-1, Physical Characteristics of Streams in the County of Elgin - Southern Area, shows the length, gradient and drainage areas of all streams in the region. It lists the streams from west to east.

STREAMFLOW

General

Very limited streamflow information is available within the study region. Daily streamflow data are available for Kettle and Catfish Creeks for limited periods. Spot measurements, taken on

most streams and their major branches during the summer and fall of 1962 and 1963, are also available.

The Federal Department of Energy, Mines and Resources, Water Resources Branch, operates a streamflow gauging station on Kettle Creek and another on Catfish Creek. The one on Kettle Creek has been in operation for periods of varying lengths from 1945 to 1948 and since 1957 has been used only as a flood station during the spring runoff period. The one on Catfish Creek has been in operation since October 1, 1964. Further particulars of these stations are shown in the table below.

Gauging Station Number	Location	Drainage Area In Square Miles	Type of Present Gauge	Remarks
$2GC_2$	Kettle Creek at St. Thomas	138	Manual	Flow affected by regulation
$2GC_{18}$	Catfish Creek near Sparta	111	Recording	

Kettle Creek

The streamflow of Kettle Creek is greatly affected by two dams operated by the St. Thomas Public Utilities Commission above the City of St. Thomas. Water is taken into storage and used for the city's water supply. During the summer and early fall when low flows in Kettle Creek are prevalent, little water is discharged over the control dams.

A table of mean monthly flows at the lower dam on Kettle Creek at the St. Thomas Water Works reservoir has been prepared by the Conservation Authorities Branch, Department of Energy and Resources Management for the water years 1951 to 1965. These flows were obtained from water-taking records, gauge-height records collected at the lower dam by personnel of the St. Thomas Public Utilities Commission and a

rating curve for the weir at this dam as prepared by Mr. W. C. Miller, P. Eng., a former city engineer of St. Thomas. A copy of this table is on file in the Division of Water Resources, Ontario Water Resources Commission.

Gauge $2GC_2$ at St. Thomas downstream from the confluence of Dodd Creek with Kettle Creek and above the sewage treatment plant has a poorly defined rating curve in the higher flow ranges. During the spring freshets the calculated discharges at this gauge location are considerably smaller than the ones determined at the lower dam of the St. Thomas Water Works even though the contributing drainage area is nearly twice as large.

Table IV-2 shows the mean flow, minimum seven-day flow, minimum one-day flow and number of days with flows less than the minimum seven-day flow for each of the summer months June to September inclusive for 1946 and 1947 at gauge $2GC_2$. The precipitation for the four-month period was 7.04 inches in 1946 and 15.94 inches in 1947 at the meteorological station at St. Thomas while the long-term summer precipitation was 12.33 inches.

Catfish Creek

Gauging station $2GC_{18}$ is located on Catfish Creek above the confluence with Bradley Creek. This location was selected because of streamflow regulation on Bradley Creek by two small mill dams. Only two years of continuous streamflow records for the water years ending in 1965 and 1966 are available for Catfish Creek. Table IV-3 shows the mean monthly, mean annual, minimum seven-day and minimum one-day flows, and the number of days with flows less than the minimum seven-day flow for each month of the water year ending in 1965 and 1966 at this gauge.

In addition to the actual streamflow data available at this gauging site, estimates were made of the mean monthly flows at this gauging site for the water years ending in 1961 to 1964 inclusive. These are shown in Table IV-3. The estimates are based upon a relationship developed between the monthly recorded discharges of Catfish Creek near Sparta and those of Big Otter Creek at Tillsonburg for the water years ending in 1965 and 1966. Using this correlation, mean monthly flows of Catfish Creek near Sparta were calculated from the mean monthly discharge of Big Otter at Tillsonburg. The estimated flows should be interpreted as approximate only.

MINIMUM SEVEN-DAY FLOWS

The minimum seven-day flow past a point on a stream is defined as the mean of seven consecutive daily flows with the lowest possible value obtainable from a set of daily flow records for a selected time period. It is an excellent indicator of the dependable flow in a stream or watercourse and should be considered in deciding a stream's usefulness for its various continuous uses. This would include allowable water taking from the stream and permissible pollution loading to its waters.

Tables IV-2 and IV-3 list the minimum seven-day flows measured at the gauges on Kettle and Catfish Creeks respectively.

From the streamflow data available in the region and from beyond, it was possible to construct a map showing estimated minimum seven-day streamflow ranges for the open water period of 1963. In order to arrive at this map, flows in the region were correlated with flows in streams outside the region, when necessary, to improve the accuracy of the estimate. Streams selected as a basis for correlation have continuous streamflow records and their basins have similar topographic,

pedologic and land use characteristics as the streams under investigation.

Figure 3 shows the streams, their basins, the streamflow gauging station locations, the major dams on Kettle Creek and the estimated minimum seven-day streamflow ranges of the streams in the region for the open water period of 1963.

CONSERVATION AUTHORITIES

Two conservation authorities, the Kettle Creek Conservation Authority and the Catfish Creek Conservation Authority, are active in parts of the study region. The Kettle Creek Conservation Authority has jurisdiction over 199 square miles consisting of the Kettle Creek Basin and those parts of areas draining directly into Lake Erie that lie within the Townships of Southwold and Yarmouth.

The Catfish Creek Conservation Authority has jurisdiction over 189 square miles consisting of the Catfish Creek Basin and the lands between Catfish Creek Basin on the west, Big Otter Basin on the north and the east limit of the Township of Malahide on the east.

Of particular interest to this study is the work undertaken by the Conservation Authorities Branch of the Department of Energy and Resources Management for the Water Section of the Kettle Creek Conservation Report. This section has not been completed as yet, but should be released in 1967. It is expected that the report will recommend several sites for future multiple purpose dams. Two of these will have very limited storage potential but the one proposed for Dodd Creek will have a storage potential of about 14,000 acre feet. This volume includes dead storage.

WATER TAKINGS

In the study area, a large number of permits for the taking of water were issued by the Ontario Water Resources Commission, the larger proportion to farmers for the taking of water for farm and garden crop

irrigation. Tobacco is the major crop irrigated in this region and its irrigation occurs generally in June and July. Table IV-4 shows the number of permits issued in each basin, the allowable takings for irrigation, industrial and municipal use, estimated takings for irrigation purposes during the early summer season and total estimated takings per basin in mgd. The Catfish and Kettle Creek Basins were divided into two parts, those above and those below the major urban centres of population.

The estimated daily takings were based upon an analysis of water-taking records collected for 1965 for the Silver Creek Basin. The year 1965 was selected because good records were available on water use under permit for that year. The daily takings of water for irrigation will vary from year to year as this water use is very weather dependent.

TABLE IV-1

PHYSICAL CHARACTERISTICS OF STREAMS

Stream	Length In Miles	Mean Gradient feet/mile	Basin Area Square Miles
Creek A	4.5	24	
Creek B	4.0	20	
Sixteen Mile Creek	7.5	17	
Ox Creek	6.0	21	
Brock Creek	5.0	21	92.8
McKay Creek	5.0	21	
Creek C	5.5	23	
Creek D	6.5	19	
Talbot Creek	14.5	9	60.1
Kettle Creek			167.2
Dodd Creek	17.5	13	
Kettle Creek above confluence with Dodd Creek	26.5	13	
Kettle Creek below confluence with Dodd Creek to mouth	14.0	7	
Catfish Creek			150.5
West Catfish Creek	16.5	18.0	
East Catfish Creek	9.0	19.0	
Catfish Creek above confluence with West Catfish Creek	20.0	6.0	
Catfish Creek below confluence to mouth	12.0	12.5	
Nineteen Creek	6.5	14.5	
Bradley Creek	3.5	23.0	
Silver Creek	6.0	12.5	15.6

TABLE IV-2

STREAMFLOW IN KETTLE CREEK AT ST. THOMAS (CFS)

GAUGING STATION $2GC_2$

BELOW CONFLUENCE WITH DODD CREEK

(Drainage Area 138 square miles)

Water Year	June	July	August	September
		Mean Monthly Flow		
1946-1947	308	7	8	31
1945-1946	64	7	4	6
		Minimum Seven-Day Flow		
1946-1947	13	5	5	8
1945-1946	14	3	2	2
		Minimum One-Day Flow		
1946-1947	9	1	4	7
1945-1946	10	2	1	2
		Number of days with flows less than the Minimum Seven-Day Flows		
1946-1947	4	2	0	9
1945-1946	4	6	1	0

TABLE IV-3

STREAMFLOW IN CATFISH CREEK NEAR SPARTA (CFS)

GAUGING STATION $2GC_{18}$

(Drainage Area 111 square miles)

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
Mean Monthly and Annual Flow													
1965-1966	45.1	53.3	186	53.3	143	250	198	52.8	39.4	5.4	4.6	5.4	86.0
1964-1965	9.1	8.0	80.2	129	382	499	320	24.8	7.9	5.8	5.9	5.1	121.4
Estimated Mean Monthly and Annual Flow													
1963-1964	5.9	6.6	4.5	11.8	8.3	164	178	80.4	8.4	6.1	83.0	9.5	47.7
1962-1963	18.2	80.0	69.0	12.5	8.3	370	138	55.0	8.5	3.5	5.1	4.7	64.9
1961-1962	12.2	17.5	22.5	23.5	22.0	330	70.5	22.6	7.0	4.2	10.2	6.1	46.1
1960-1961	8.1	12.3	7.4	5.8	110	102	195	118	45.5	14.0	27.0	6.2	53.7
Minimum Seven-Day Flow													
1965-1966	7.9	15.2	59.2	12.9	11.2	133	51.5	16.9	11.3	2.5	3.6	3.6	2.5
1964-1965	7.7	6.5	9.0	22.0	48.8	89.4	119	11.7	6.3	4.3	3.9	4.6	3.9
Minimum One-Day Flow													
1965-1966	5.5	13.8	39.3	12.0	11.0	90.0	43.4	14.2	8.7	1.8	2.7	3.0	1.8
1964-1965	7.4	5.8	?	?	?	51.2	78.5	10.3	5.5	3.9	3.6	3.9	3.6
Number of days with flows less than the Minimum Seven-Day Flow													
1965-1966	9	4	11	2	5	12	4	4	4	4	5	3	4
1964-1965	3	3	?	?	?	7	3	3	5	5	4	9	4

TABLE IV-4

WATER TAKINGS UNDER OWRC PERMITS (MGD)

Basin	Number of Permits	Allowable Takings: Irrigation: Farm & Garden Crops	Allowable Takings: Irrigation: Golf Course Greens	Allowable Takings: Ind.	Allowable Takings: Mun.	Allowable Takings: Total Takings	Estimated Takings For Irrigation: Farm & Garden Crops	Estimated Takings For Irrigation: Golf Course Greens	Total Estimated Takings: Direct from streams and dug-out ponds connected to or near streams	Total Estimated Takings: Other Sources
Western Area (west of Talbot Creek)	6	1.33	---	---	---	1.33	0.40	---	---	---
Talbot Creek	---	---	---	---	---	---	---	---	---	---
Kettle Creek										
(above St. Thomas)	1	---	---	0.05	---	0.05	---	---	---	---
(below St. Thomas)	9	2.10	---	---	---	2.10	0.63	---	0.12	0.51
Catfish Creek										
(above Aylmer)	12	2.45	---	---	0.24	2.69	0.74	---	0.30	0.44
(below Aylmer)	49	13.50	0.09	---	---	13.59	4.05	0.09	2.01	2.13
Silver Creek	37	9.75	---	---	---	9.75	2.93	---	---	---
Eastern Area (east of Silver Creek)	7	2.05	---	---	---	2.05	0.62	---	---	---
Yarmouth (area between Kettle & Catfish Basins)	6	2.16	---	---	---	2.16	0.65	---	---	---

V

POLLUTION CONTROL

EXISTING FACILITIES

The only municipalities with water pollution control plants in operation at the present time are the City of St. Thomas and the Town of Aylmer. A third plant serves the Ontario Police College in the Township of Malahide north-east of Aylmer. Two new water pollution control plants have been proposed, one for the Village of Dutton and one for the Village of Port Stanley. The sanitary and industrial waste treatment facilities to serve the new Fort Plant in the Township of Southwold have been approved by the Commission.

At present, none of the existing plants are overloaded either hydraulically or organically. However, it is suspected that the flows in the receiving streams are not sufficient to assimilate the loadings imposed on them by the discharge of even the treated effluents from these plants. A summary of information pertinent to the existing and proposed pollution control facilities is contained in Table V-1 (a) and (b). The quality of the effluents discharged from the existing plants is summarized in Table V-3.

RECEIVING STREAM EVALUATIONS

In order to evaluate the capacity of a stream to receive waste discharges without seriously deteriorating the quality of the river water or the aesthetics of the watershed, the stream flow, water quality and the quality of the wastes discharged into the stream must be studied and correlated. There are several ways in which this can be accomplished. The two most common methods are an assimilation study or the application of a dilution factor.

The assimilation study is the most accurate method of determining the allowable waste loading that a stream can receive. This requires a detailed study of the flow in the stream, the dissolved oxygen levels in the water, water temperature, the waste loadings and the quality of the river water. It is possible to predict the allowable waste loading that a stream could absorb fairly accurately by this method.

In applying a dilution factor it is generally necessary to have a good record of the flow in the stream, the water quality and the amount and quality of the wastes to be discharged. The inaccuracy inherent in this method is introduced because it does not allow for the regenerative capacity of the stream which is determined in an assimilation study.

With respect to this particular region, an assimilation study has been conducted on Kettle Creek. The remaining streams were evaluated by considering the available dilution.

Generally the object of these studies is to maintain the quality of the river water within the following limits prescribed by this Commission.

Surface Water Quality Objectives

5-Day BOD - not greater than 4 ppm

M.F. Coliform Count - Logarithmic Average not greater than 2400 per 100 ml of sample

In most streams, where there is a good base flow and normal water quality these objectives can be maintained providing the waste discharge is equal to one sixth or less of the flow in the stream and has characteristics which fall within the following limits also prescribed by the OWRC.

Waste Effluent Quality Objectives

5-Day BOD - not greater than 15 ppm

Suspended Solids - not greater than 15 ppm

The allowable levels of various other elements which may be present in a waste effluent are flexible to certain degrees depending on the uses which are made of the water in the river downstream (i.e. iron, cyanide, phenols, etc.). Table V-3 outlines the past quality of the waste effluents from the water pollution control plants in the region from 1963 to the present.

Western Watersheds

This category is intended to include Creek "A", Creek "B", Sixteen Mile Creek, Ox Creek, Brock Creek, McKay Creek, Creek "C", and Creek "D" as shown on Figure 3, in short, all of the watercourses west of Talbot Creek. Information concerning the quality of these surface waters is very limited. This is largely due to the fact that there is little urbanization in the areas they drain and also because the flow in each of them is marginal during the summer.

Table V-2(b) indicates the quality of Sixteen Mile Creek below Rodney. The analyses indicate that this creek is being polluted by discharges from the Village of Rodney to an extent that is beyond the objectives of this Commission. Figure 3 indicates further that during dry periods there is little or no flow in this stream. On the basis of this information, it is concluded that the Village should provide adequate treatment facilities for its wastes and that discharges of effluent from these facilities should be carefully controlled to ensure that sufficient dilutional flow is available in the creek.

By comparison, it is quite apparent that similar conclusions can be made for the remainder of the streams categorized under the "Western Watersheds" particularly Brock Creek which drains the

Village of West Lorne and Creek "D" which drains the Village of Dutton.

Talbot Creek

Figure 3 indicates that there is little or no flow in Talbot Creek during dry periods. This condition immediately limits the use that can be made of this stream for waste assimilation purposes. Table V-2(b) indicates that near the mouth of the creek the water quality is generally satisfactory according to the present standards.

As there is little or no dilutional flow in the creek at times and because there are no significant urban centres in the watershed at present, two conclusions can be reached. The first is that this creek should not be used for assimilating waste effluent discharges if at all possible. The second is that in order to maintain the existing water quality in the creek, further urbanization in the watershed should be discouraged thus eliminating the possibility of waste effluent discharges occurring at some future date.

Kettle Creek

An assimilation study of Kettle Creek from the City of St. Thomas to Lake Erie was conducted from August 23 to August 26, 1966 by the Water Quality Surveys Branch of the Division of Sanitary Engineering of the Ontario Water Resources Commission. The findings of this study were that the waste loading from the St. Thomas WPCP was greater than the stream could assimilate. In actual figures it was determined that the creek was capable of assimilating 180 pounds of BOD. This is equivalent to 1.2 mgd of waste effluent containing 15 ppm BOD. In comparison, the average daily flow presently being discharged from the St. Thomas Water Pollution Control Plant is 2.0 million gallons approximately. The average strength of the effluent sampled between 1963 and the present has been 16.5 ppm BOD. (Table V-3) This represents a waste loading of 330 pounds of BOD per day. The results

of this overloading can be seen in the results of the analyses of water samples collected at stations 4, 5 and 6 on Kettle Creek. (Table V-2(b))

The conclusions reached, therefore, are that the waste loading from the St. Thomas WPCP must be reduced. Any additional waste loadings that may be introduced at some future date at other points in the watershed must be controlled to ensure that they, in turn, do not overload the assimilation capacity of Kettle Creek. This conclusion will apply to the Ford Motor Company of Canada which is planning a discharge to Dodd Creek, which has only marginal summer flow (Figure 3); and also to the Village of Belmont which is located in the headwaters of Kettle Creek where there is little or no summer flow and which will require water pollution control facilities if it is to develop further. An alternative to reducing the waste loading from St. Thomas would be the augmentation of the flow in Kettle Creek which should increase the assimilation capacity of the creek. This might also allow for additional waste loadings at other points on the stream. Ultimately it appears that all waste loadings will have to be eliminated from the creek, especially if the St. Thomas area is to develop further.

The Village of Port Stanley which is located at the mouth of Kettle Creek is planning water pollution control facilities that will have seasonal discharges to Kettle Creek. Initially this probably will be satisfactory. Ultimately the discharge should be redirected to Lake Erie. This would be wise because of the backwater effect in the creek caused by Lake Erie.

When streams containing water pollution control plant effluents encounter backwaters, the coarser solids settle causing sludge banks to form. The resultant clarification and quiescence also favours

algae growth. In addition the Village of Port Stanley is a summer resort; therefore it would be preferable not to discharge to Kettle Creek as it might spoil the aesthetic qualities of the creek and the lake shore.

Catfish Creek

The water quality in Catfish Creek at each of the five stations chosen compared favourably with the OWRC objectives. (Table V-2(b)) At the present time, two water pollution control plants discharge effluent to Catfish Creek. These are the Ontario Police College north-east of Aylmer and the Town of Aylmer plant. Table V-3 indicates that the quality of effluent from both of these plants is poorer than the desired objectives.

The flow in Catfish Creek during periods of drought is very low above Aylmer and in the major tributaries. (Figure 3). The flow below Aylmer increases considerably after the confluence of West Catfish Creek with the main stem of the creek. Study of the dilutional flows available in the creek at various times of the year and correlation with the existing quality of the creek water and the waste effluents from the two existing water pollution control plants would appear to support the conclusion that waste effluents can continue to be discharged at Aylmer if they are carefully controlled to occur when sufficient dilutional flow is available in the creek. The discharge from the Ontario Police College plant should be stored and discharged seasonally. If at some future date water pollution control facilities are required at the Village of Springfield, seasonal discharge should be practised also. It should be explained that seasonal discharge is taken to imply that the effluent from the pollution control facilities would be stored in a holding pond and discharged when adequate dilutional flows are available.

GENERAL CONSIDERATIONS

There is only one large urban centre in the study region where any likelihood of extensive growth exists. Consequently there is only one area where large volumes of sewage will be generated. This is the St. Thomas area. The problems of water pollution control in this area are not encountered in the remainder of the study region.

Numerous methods of sewage treatment and disposal were considered for the municipalities. Due to their size, location, anticipated growth and receiving stream flow, facilities designed for controlled discharge during selected periods of the year would probably be suitable for the Town of Aylmer and the Villages of Belmont, Dutton, Rodney, Springfield and West Lorne for the foreseeable future. The Village of Port Stanley probably will be served by a similar system for the initial 20 year development period with some changes thereafter as outlined later in this report.

The methods of future sewage treatment and disposal for the St. Thomas area that were investigated included:

1. The expansion and continued use of the existing St. Thomas WPCP with the provision of tertiary treatment facilities including nutrient removal;

2. The construction of holding ponds (lagoons) for either effluent or raw sewage, with controlled discharge during suitable flow periods in the receiving stream;

3. Disposal of all or part of the effluent on land during periods when the flow in the receiving stream is insufficient to assimilate the waste load from the WPCP;

4. Facilities to ensure consistent effluent quality (below 15 ppm BOD) with flow augmentation, through the use of impoundment reservoirs or wells, to maintain satisfactory stream conditions;

5. Conveyance of the WPCP effluent to Lake Erie either through an open channel or a sewer;

6. Conveyance of raw sewage through a sewer to a new plant near Port Stanley with effluent discharge to Lake Erie;

7. The introduction of reaeration facilities in the receiving stream to increase its assimilation capacity;

8. The disposal of effluent by means of deep wells;

9. A combination of the preceding.

Discussion of Alternatives for the St. Thomas Area

Alternative 1

All of the methods previously outlined have some merits and some problems associated with them. The St. Thomas WPCP was built in three approximately equal stages in 1942, 1954 and 1966. Consequently, a large portion of this plant has a useful life of at least 20 years. Despite this however, tertiary treatment methods presently known to be successful are extremely expensive. Further, it has not been adequately established that the degree of phosphate removal provided by these works is sufficient to prevent the excessive growth of algae and aquatic plants. This alternative does not appear to be too promising therefore when the expense involved and the indeterminate results are considered.

Alternative 2

Effluent or raw sewage holding ponds with controlled discharge during suitable streamflow conditions, should provide suitable receiving stream conditions. However, storage would probably be required for a period of approximately 300 days and at the 1987 estimated population and sewage flow, the storage capacity necessary would approximate 220 million cubic feet, or 1,250 acres of liquid four feet deep.

The land purchase, pumping, construction and maintenance of this method would appear to be prohibitively costly. In addition, an expansion or alternate means of disposal would be necessary after 1987.

Alternative 3

The disposal of effluent on land during low flow conditions would probably produce satisfactory stream quality conditions also. However, storage facilities would be required for the winter months and large areas of land would be required for spraying purposes. In addition, the soil characteristics in the spray area would have to be suitable. A perusal of the soils map for this area indicates that large areas of suitable soil are not available near St. Thomas.

Alternative 4

A review of the available information suggests that two reservoir sites are available, one on Dodd Creek and one immediately upstream of the existing St. Thomas reservoirs. If dams were built and utilized primarily for flow augmentation, it might be conceivable that the existing plant could be used for some time. These reservoirs would have only limited use for other purposes such as flood control, recreations, etc., since it might be necessary to virtually drain the reservoirs during dry periods in order to provide adequate flow for effluent dilution. It is doubtful whether wells could be used for flow augmentation, since the existing St. Thomas wells already cause some interference with private wells. In addition, a number of wells would be required since the probability of obtaining high capacity wells without interfering with private wells or stream flow, is slight.

Alternatives 5 & 6

It would appear that the ultimate solution to the problem of the disposal of effluent in the St. Thomas area, is direct discharge

to Lake Erie. The means of conveying the effluent, and whether or not raw sewage should be conveyed with a new plant built near the lake, are primarily economic considerations. This method would require a fairly long sewer (approximately 12 miles through the creek valley, 7.5 miles by a more direct route) and would probably be expensive for the population served at present (25,000).

Alternative 7

The introduction of reaeration facilities in the stream could provide a means of increasing the allowable waste discharge to the creek at St. Thomas. One thought was that these facilities would consist of a series of weirs on the creek, at suitable intervals between St. Thomas and Lake Erie. However, the river gradient between the city and the lake averages only 7 feet per mile. With this low gradient and the negligible summer river flows, it is exceedingly doubtful if this means alone would greatly improve the creek's assimilating properties.

Alternative 8

Deep well disposal of the effluent would be a very satisfactory solution if suitable geological formations were available. Upon examination of the geology and well logs in this area, it was concluded that this possibility was impractical.

Alternative 9

There are several combinations of methods that might be considered. For instance, detailed study of one reservoir site and its hydraulic aspects might reveal that a certain stream baseflow could be maintained. When the reservoir is constructed and the baseflow produced, an assimilation study might reveal that the river could handle more load than had been originally calculated.

The converse likewise may occur. In addition, reaeration on the stream by means of weirs may be practical when a more substantial baseflow is available.

Another combination might be the construction of a sewer from St. Thomas southward, to convey plant effluent for a period of years and subsequently, when the capacity or usefulness of the existing plant is exceeded, raw sewage to a plant near the lake.

Consideration should be given to the location and type of future development. It may be practical to limit development in the immediate St. Thomas area to that from which the waste effluent load can be assimilated by the stream with the limited flow augmentation that can be provided. Additional development can be more cheaply serviced if it is situated closer to the lake. This would probably involve the creation of a new centre of population south of St. Thomas with the associated problems of planning, roads, suitable land, etc. This degree of planning is far beyond the scope of this report. However, some control could be imposed by the city so as to restrict the type of industry locating in the city to that with small volumes of easily treatable waste or with no wastes except sanitary. This would produce optimum use of the available plant capacity and stream assimilation characteristics, and would allow for the construction of a smaller size of sewer when this is built to the lake.

Conclusion

All of the streams in the study area are inadequate under present conditions to support a water pollution control facility of the size required to serve the present and projected future populations and of the type requiring a continuous effluent discharge. Consequently only four alternatives for sewage treatment works exist if the streams are to be maintained in satisfactory condition at all

times. These are: the prevention of effluent discharges to the watercourse; the restriction of the period of the year during which discharge can occur (i.e. seasonal discharge); the treatment of the sewage to a degree that it will not effect the stream regardless of the flow; and, the improvement of the condition of the creeks so that certain treated waste loadings can be assimilated satisfactorily by the stream. The second alternative would appear to be practical where land requirements for storage are relatively small and land cost, topography and soil characteristics are reasonable. For the central, more densely populated area, alternative four would appear to be most amenable to staging.

It would be most advantageous to guide development in the study area since, based on our present knowledge and judgement, it would appear that at some future date, the effluent from water pollution control facilities in the central area will have to be discharged directly to the lake. Consequently, the closer development is to Lake Erie, the shorter the means of effluent conveyance and thus the lower the cost.

ADDITIONAL WORKS REQUIRED

With the exception of the municipalities in the central section of the study area, sewage treatment facilities in the built-up communities should consist of waste stabilization ponds with effluent control works. In addition, flow measuring devices on the receiving stream near the point of effluent discharge would be useful. These devices could be of the manual variety and would be calibrated such that the rate of discharge from the waste stabilization pond could be controlled according to the flow measured in the receiving stream. The allowable rate of discharge would be derived from assimilation studies undertaken on the stream during periods of varying stream flow.

Sewage treatment facilities of this type would be suitable for the Town of Aylmer, the Villages of Belmont, Dutton, Rodney, Springfield, West Lorne, and initially Port Stanley. Ultimately, facilities for the Village of Port Stanley might be incorporated in an overall scheme to serve the central area of the County as discussed later in this section of the report.

The Village of Springfield may be able to utilize the activated sludge type sewage treatment plant at the Ontario Police College as an alternative. This is a 0.083 mgd plant and the flow from the college approximates 0.020 mgd at present. The continued use of the college, the possible expansion of same and the agreement that can be reached for joint use of the water pollution control plant are factors that will affect the decision. The effluent from the water pollution control plant will have to be held during low flow periods. This solution will provide one plant for two centres and thus allow better operational control. If this possibility cannot be accomplished, separate works for the village as outlined in the previous paragraph will have to be considered.

For the City of St. Thomas and the surrounding areas of the Townships of Southwold and Yarmouth, it would appear that flow augmentation and effluent quality control facilities would be the most reasonable solution for the next 20 years. With minor renovations and additions to the St. Thomas WPCP, it should be possible to ensure that up to 4.5 mgd of sewage can be treated to produce an effluent with a BOD consistently less than 15 ppm. Based on the results obtained from the previously discussed assimilation study which was undertaken during low flow conditions, it has been estimated that with a sustained flow of 30 cfs, the stream may be able to assimilate approximately 650 pounds of BOD from the St. Thomas plant. With an

effluent quality of 15 ppm BOD, this represents a flow of 4.3 mgd which is the approximate capacity of the existing St. Thomas WPCP. Considering the 1987 estimated per capita sewage contribution, this represents a population of 39,300. The projections utilized in this report indicate a 1987 equivalent population of 34,500 within the city boundaries. In addition, there is and will be some limited development outside of the city which should be contributory to this water pollution control plant. This is expected to amount to some 4,000 persons by 1987 bringing the total area population to 39,500 persons. These figures would seem to indicate that with flow augmentation, the existing plant with some modifications, could be used until 1987. At this date, the three sections of the plant would be 45, 33 and 21 years old respectively and probably extensive rehabilitation would be required to serve beyond this date.

A brief study of the potential reservoir sites on Kettle and Dodd Creeks, which did not include any field investigations, has indicated that two such sites exist. The first, on Dodd Creek, was originally selected by the Conservation Authorities Branch of the Department of Energy and Resources Management and proposed for multi-purpose use such as flood control, recreation and streamflow augmentation. The storage potential is approximately 12,000 acre-feet and if the reservoir was built and used only for streamflow augmentation, it is estimated that it would yield a dependable flow of 20 cfs. The second site is on Kettle Creek immediately above the existing water-supply reservoir of the City of St. Thomas. It is estimated that this reservoir could have a useable capacity similar to the one on Dodd Creek, and if operated only for streamflow augmentation, could yield a dependable flow of at least 20 cfs during the low flow period. Since the preparation of the information was based on very limited

streamflow data, the estimated streamflow augmentations calculated should be considered to be of a conservative nature. The reservoirs, when used primarily for streamflow augmentation, could likely provide some flood control protection. This proposal is amenable to staging with the construction of one reservoir at the present time. When the augmented flow is available, further stream assimilation studies could be undertaken to more accurately assess the effect of this flow. With increased river flow, it may be possible to provide reaeration facilities on the watercourse to further improve the stream's assimilation capacity. However, additional study is required to determine accurately the most suitable reservoir sites and the amount of flow that would be available from each.

This proposal for ensuring satisfactory stream quality will require little expenditure at the present time, other than that required for the reservoir construction and operation. It will also allow a period of time during which a radical development in the science of sewage treatment may occur. It might then be possible to produce a high quality effluent which could be discharged to any stream regardless of the flow. In addition, at some future date, a study might reveal that the Thames River could not support the organic load imposed upon it by the City of London. If this occurred, and the solution appeared to be the transportation of effluent to one of the Great Lakes or raw sewage to a large plant at one of the lakes, then it would appear that the most economical lake to be considered would be Lake Erie. The trunk sewer from London to Lake Erie would probably pass through the St. Thomas area, and a small increase in the size of the sewer would permit the servicing of the St. Thomas area in the larger scheme.

Ultimately, the central urban area may be served by a trunk sewer from a point in the St. Thomas area to a large water pollution control plant at Lake Erie. In that event it would appear reasonable that development in St. Thomas should be limited to approximately 40,000 persons and growth beyond this should be encouraged to the south as near Lake Erie as practical. The closer the development is to the lake, the shorter the length of large size trunk sewer that will be required to convey raw sewage to a new plant near the lake. This plant would be built by approximately 1987 and would be designed to treat flows from the St. Thomas area, a growth area south of the city and the Village of Port Stanley. When the plant and connecting trunk sewers are completed and operational, the reservoir(s), built in the first stage of the programme would revert to other major uses, such as flood control, recreation, etc.

If Kettle Creek is to be used for water supply purposes by the City of St. Thomas in the future, additional reservoir construction will be required to ensure an adequate quantity. The use of a reservoir for water supply purposes is not generally compatible with the use of the same facility for streamflow augmentation. Therefore if the creek is to be used as a source of raw water in the future, the effluent from sewage treatment facilities in the St. Thomas area will have to be discharged directly to Lake Erie. In this case, it is probable that the sewer would be designed to convey plant effluent until the capacity and usefulness of the existing plant is exceeded. Beyond this time, the sewer would carry raw sewage to a new plant located near the lake. Under this solution, the more control that was placed on growth in the St. Thomas area, the smaller the required size of sewer and consequently the lower the cost.

The one remaining problem will be the waste generated by development of the two blocks of land owned by the Ford Motor Company of Canada Limited. If a reservoir is constructed on Dodd Creek for any purpose, the effluent from the proposed Ford waste treatment facilities should be discharged to the creek below the reservoir. When the southern property is developed, the wastes should all be directed to the St. Thomas plant if it is still in operation, or to the trunk sewer leading to the lake. If a reservoir is not constructed, and an effluent sewer is built from St. Thomas to the lake, then the effluent from the Ford WPCP should still be directed to the effluent sewer.

TABLE V-1

(a)

EXISTING WATER POLLUTION CONTROL PLANTS

Municipality	Type	Design Capacity	Receiving Stream
City of St. Thomas	Activated Sludge	Primary - 3.6 mgd @ 2.5 hours retention Aeration - 4.4 mgd @ 6 hours retention plus 25% return Final - 5.8 mgd @ 2.5 hours retention	Kettle Creek
Town of Aylmer	Lagoon	70 acres - design population 5,000 persons plus industry	Catfish Creek
Township of Malahide (Ontario Police College)	Activated Sludge Mechanical Aeration	0.083 mgd	Ditch to Catfish Creek

(b)

PROPOSED WATER POLLUTION CONTROL PLANTS

Municipality	Type	Design Capacity	Receiving Stream
Village of Dutton	Lagoon Seasonal Retention	not finalized	Bennett Drain
Village of Port Stanley	Lagoon Seasonal Retention	immediate - 20 acres ultimate - 40 acres	Kettle Creek
Township of Southwold Ford Motor Company Limited	Sanitary - Extended Aeration	0.083 mgd	Tributary to Dodd Creek (Kettle Creek Watershed)
	Industrial - Coagulation & Sedimentation	0.200 mgd	
	Storm Water & Effluent Holding Pond	10 mg	

TABLE V-2

SANITARY WATER QUALITY

(a) STATION DESCRIPTIONS

Station	Corresponding River Survey Sampling Point	Description
	Sixteen Mile Creek	
1	S-5.0	Bach Street just south of Rodney
	Talbot Creek	
2	T-0.7	East Talbot Road, Port Talbot
	Kettle Creek	
3	K-0.3	Lift bridge in Port Stanley
4	K-1.3	First bridge above Port Stanley
5	K-8.2	West of Highway No. 4 south of Ontario Hospital
6	K-11.8	Railway trestle below WPCP
7	KP-12.2	Pinafore (Mill) Creek at Highway No. 4
8	KD-14.4	Dodd Creek at Highway No. 4
9	K-17.2	Below north water works dam, St. Thomas
10	K-27.6	One mile south-west of Belmont
	Catfish Creek	
11	C-0.6	Bridge north of Port Bruce
12	C-10.0	1.5 miles west of Jaffa
13	CW-14.7	West Branch at Highway No. 3
14	C-15.5	Highway No. 3 just west of Orwell
15	C-21.6	East boundary of Aylmer

TABLE V-2
(CONT'D)

SANITARY WATER QUALITY

(B) MAXIMUM, MINIMUM AND AVERAGE RESULTS

ANALYSIS		SIXTEEN MILE CREEK STATION 1	TALBOT CREEK STATION 2	KETTLE CREEK STA. 3	STA. 4	STA. 5	STA. 6	STA. 7	STA. 8	STA. 9	STA. 10	CATFISH CREEK STA. 11	STA. 12	STA. 13	STA. 14	STA. 15
BOD	NO. OF SAMPLES	16	18	31	22	19	39	20	8	13	13	24	5	4	5	6
PPM	MAXIMUM	10	3.9	16.0	15	18	18.0	7.2	11	8	26	6.4	5.6	2.8	5.2	2.5
	MINIMUM	1.1	0.7	0.6	2.0	3.1	2.0	1.6	0.9	0.7	0.5	0.4	1.8	0.8	2.4	1.6
	AVERAGE	4.1	2.3	3.6	5.6	8	6.7	4.0	3.6	3.2	5.9	2.6	3.3	1.8	3.7	2.1
SUSP.	NO. OF SAMPLES	16	17	26	8	6	26	7	6	8	10	21	2	2	2	3
SOLIDS	MAXIMUM	386	98	174	184	224	184	54	78	146	20	116	58	46	30	48
PPM	MINIMUM	<15	8	20	25	18	14	6	12	8	4	8	19	7	28	24
	AVERAGE	63	51	48	83	92	39	28	46	35	22	43	38	26	29	33
TURB.	NO. OF SAMPLES	15	16	22	3	4	19	2	2	6	4	20	3	2	3	3
UNITS	MAXIMUM	84.0	103	120	65	84	68	4	53	16	28	91	39.0	48.0	12	30
	MINIMUM	6.5	7.5	9	31	15	4.0	4	18	4	4	6.5	11.5	15	10.0	10.5
	AVERAGE	24.6	40.8	36	45	42	22.7	4	36	11	12	33.9	22	32	11.0	17
TOTAL	NO. OF SAMPLES	16	16	20	2	4	20	3				19				
PHOS-	MAXIMUM	11.0	0.60	4.00	4.70	10.0	18.20	5.00				1.30				
PHORUS	MINIMUM	0.16	0.08	0.30	4.50	7.0	0.34	4.20	-	-	-	0.20	-	-	-	-
AS PO_4	AVERAGE	1.29	0.28	1.01	4.60	9.3	9.60	4.53				0.51				
PPM																
NITRATE	NO. OF SAMPLES	16	16	20	3	5	21	3	1	8	8	19				
AS N	MAXIMUM	1.80	4.00	3.75	1.30	4.50	10.0	1.00		4.0	3.2	3.00				
PPM	MINIMUM	TRACE	0.00	0.00	0.02	0.40	0.00	0.40		TRACE	0.0	0.00	-	-	-	-
	AVERAGE	0.65	0.92	0.92	0.84	2.18	2.10	0.63	0.8	0.73	0.65	0.61				
*COLI-	NO. OF SAMPLES	17	22	29	9	9	29	7	5	7	7	24	4	3	4	4
FORMS	MAXIMUM	340,000	72,000	560,000	35,000	55,000	4,100,000	151,000	22,000	540	860,000	114,000	9,000	530	95,000	19,000
	MINIMUM	3,000	20	<100	510	4,000	12,000	30	570	2	670	34	140	100	230	200
	AVERAGE	43,950	470	5,859	4,124	31,360	141,600	19,400	2,053	48	35,060	814	760	195	6,770	1,686
ANIONIC	NO. OF SAMPLES			6	6	3	5	5	4	4	3					
DETER-	MAXIMUM			0.3	0.7	0.7	2.3	0.6	0.0	0.0	0.0					
GENTS	MINIMUM	-	-	0.2	0.2	0.3	0.3	0.2	0.0	0.0	0.0	-	-	-	-	-
AS ABS	AVERAGE			0.25	0.3	0.5	1.0	0.4	0.0	0.0	0.0					
PPM																

* COLIFORMS = M.F. COLIFORMS PER 100 ML; AVERAGE = LOGARITHMIC AVERAGE

TABLE V-3

WASTE EFFLUENT QUALITY

Analysis		Kettle Creek St. Thomas WPCP	Catfish Creek Ontario Police College WPCP	Catfish Creek Aylmer WPCP
BOD ppm	No.of samples	23	14	16
	maximum	52	82	28
	minimum	4	4.2	2.4
	average	16.5	24.8	9.8
Susp. Solids ppm	No.of samples	22	14	15
	maximum	95	42	103
	minimum	1	2	6
	average	22	24	31
Nitrate as N ppm	No.of samples	6	-	13
	maximum	10.00		1.75
	minimum	0.00		0.00
	average	2.29		0.38
M.F. Coliforms per 100 ml	No.of samples	9	3	-
	maximum	1,530,000	84,000	
	minimum	93,000	9,300	
	logarithmic average	491,100	39,680	

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* - The sources of articles 34, 35 and 36 are one and the same, the name of the Federal Department having been changed twice since 1964.

LIST OF ABBREVIATIONS

WPCP	-	Water Pollution Control Plant
BOD	-	5-Day Biochemical Oxygen Demand
Susp. Solids	-	Suspended Solids
Turb.	-	Turbidity
M. F. Coliforms	-	Total Coliforms as determined by Membrane Filter Technique
ppm	-	Parts per Million
MGD, mgd	-	Million Imperial Gallons per Day
mg	-	Million Imperial Gallons
gpd	-	Imperial Gallons per Day
CFS, cfs	-	Cubic Feet per Second
WPCF	-	Water Pollution Control Federation
OWRC	-	Ontario Water Resources Commission
AWWA	-	American Water Works Association
A.S.C.E.	-	American Society of Civil Engineers